NASA CR 101956

Date 15 September 1969

Revised

LIMITED REPORT

METALLOGRAPHIC EXAMINATION OF SOLDERING OF MULTILAYER BOARDS FOR AIRLOCK

Report 061-015-76 Model Airlock

Contract No. NAS9-6555

Laboratories: Materials

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METALLOGRAPHIC EXAMINATION OF SOLDERING OF MULTILAYER BOARDS FOR AIRLOCK

The object of this test was to evaluate the solder connections of components on multilayer boards. This test became necessary when Electro-Mechanical Research (EMR) Co. requested a deviation from MDC. P.S. 22800 in soldering components on multilayer boards. EMR indicated that incomplete solder flow into the plated holes occurs because of the heat sink created by eleven copper layers, ground planes, and shields.

A multilayer board (P/N 52-203-403-80041) which had not been fully soldered was obtained from EMR, and various fluxes and soldering techniques were applied. A photograph of the as received multilayer board with arrows indicating connectors selected for examination is shown as Figure 1 on page 4. The conditions under which the connections were prepared and the visual results are shown in Table 1 on page 3.

The selected hole areas were sectioned and mounted for metallographic examination. Photomacrographs and photomicrographs of each of the examined hole areas are shown in Figures 2 through 12 pages 5 through 13. The following observations were made during the examination of the hole areas:

1. Connections C, DE, and F showed incomplete solder flow as shown in Figures 4, 5, and 6, respectively.
2. Hole "U" (designated as the unsoldered hole), which had been copper-tin-lead plated but which did not have a solder connection, showed evidence of a void in the solder plate and a crack in the copper plate. This condition is shown in Figure 10 on page 13. Repolishing of the specimen confirmed that the copper plate was fractured 0.07 inch below the top face of the board, (Figure 11 on page 13).

3. Thickness measurements of the solder layer and the copper plate were made on the unsoldered hole from the photomicrograph in Figure 13 on page 13. The thicknesses were as follows: average copper plate-0.0024 inch, solder layer-0.0013 inch.

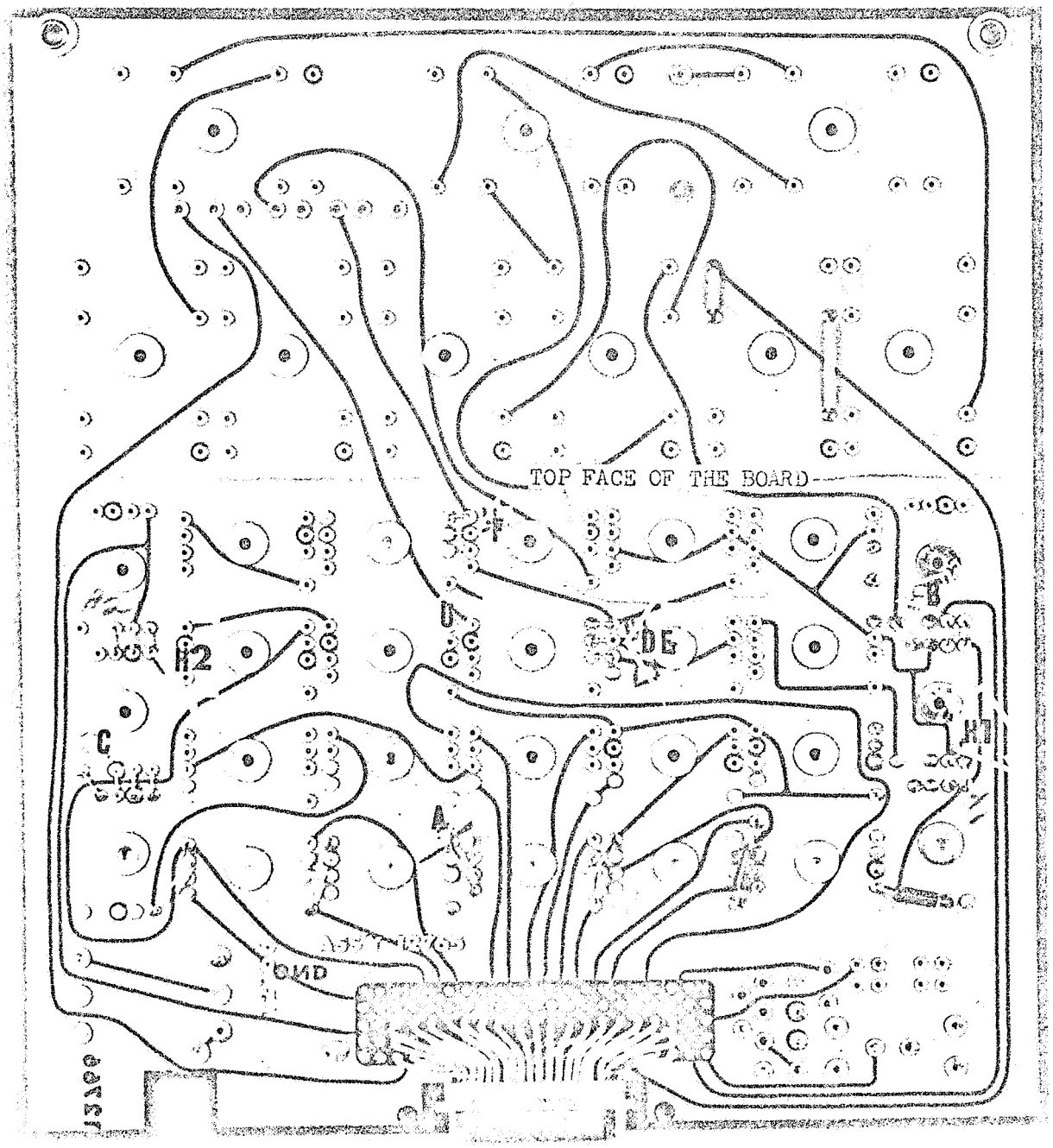
CONNECTION PREPARATION FOR MULTILAYER BOARD P/N 52-203-403-80041

PC BOARD SECTION	PC BOARD CLEANER	PC BOARD FLUX	SOLDER TEMPERATURE RESERVOIR	MACHINE CONVEYOR SPEED FT/MIN	VISUAL RESULTS
A	Alpha 563	Kester 1571	500-525°F	2.6	Complete Flow
B	Alpha 563	Kester 1571	500-525°F	3.5	Complete Flow
C	Alpha 563	Kester 1571	500-525°F	4.0	Complete Flow
D	Alpha 563	Kester 196	500-525°F	4.0	Incomplete Flow
E	Alpha 563	Kester 196	500-525°F	4.0	Incomplete Flow
F	Alpha 563	Kester 196	500-525°F	3.0	Incomplete Flow
H1	Alpha 563	Kester 1571	Hand Soldering		Touch Up Required
H2	Alpha 563	No Flux	Hand Soldering		Incomplete

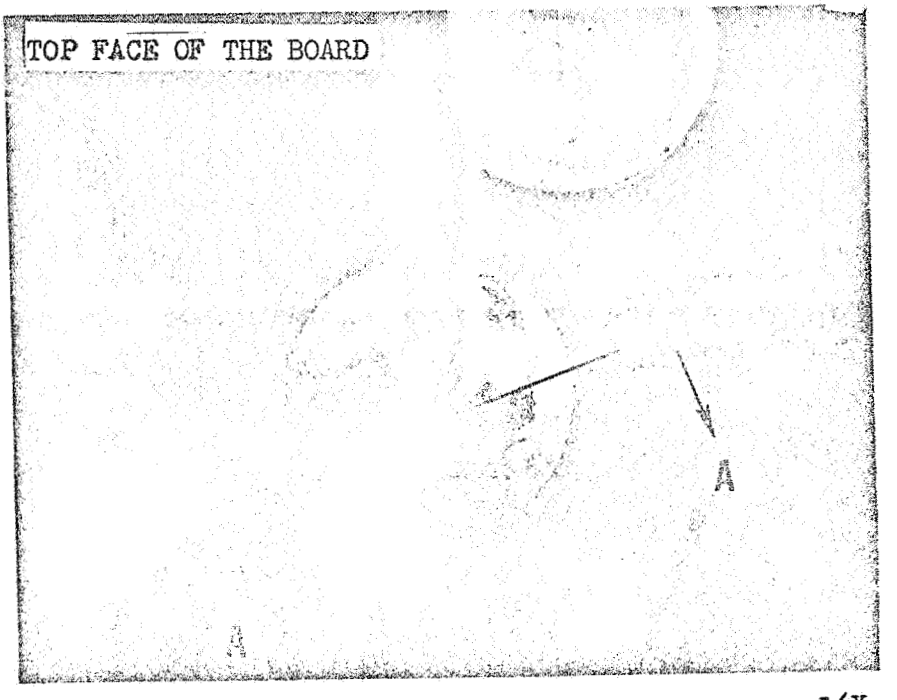
TABLE 1

FIGURE 1

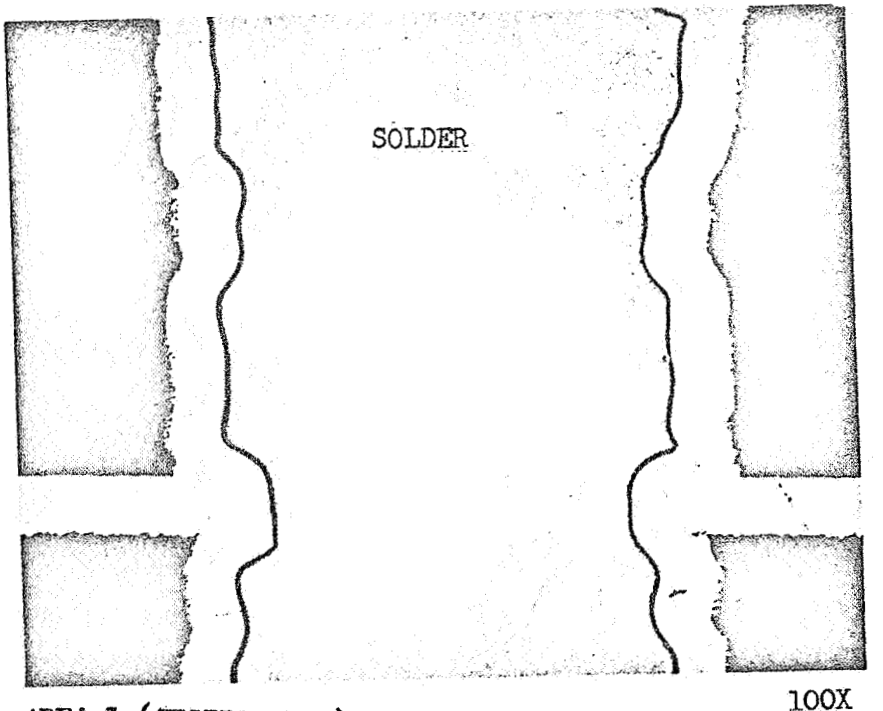
AS-RECEIVED CIRCUIT BOARD (THE CONNECTIONS TO BE SECTIONED ARE MARKED WITH ARROWS)



CONNECTION A SHO



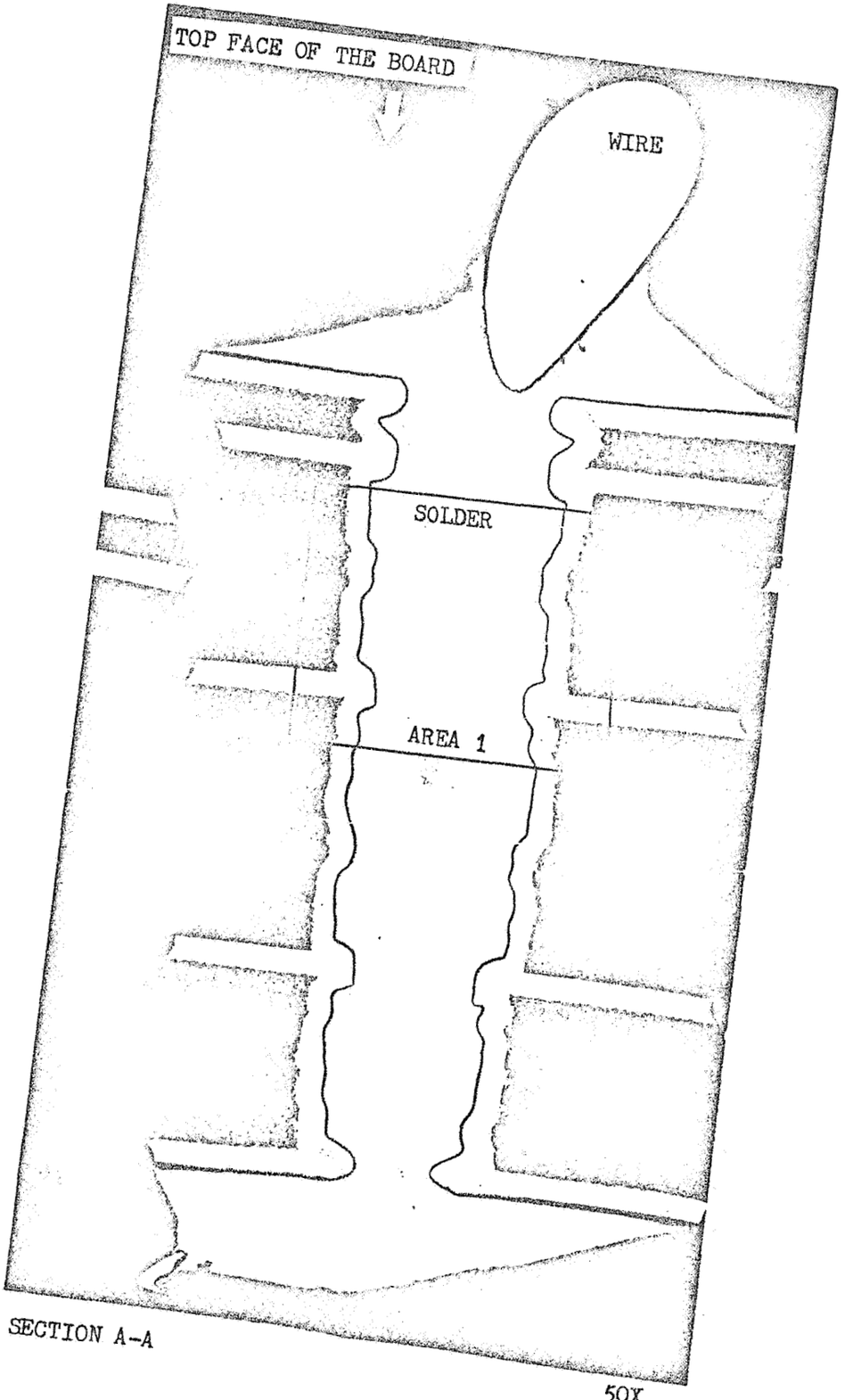
CONNECTION A 16X



AREA 1 (SECTION A-A) 100X

COMPLETE SOLDER FLOW

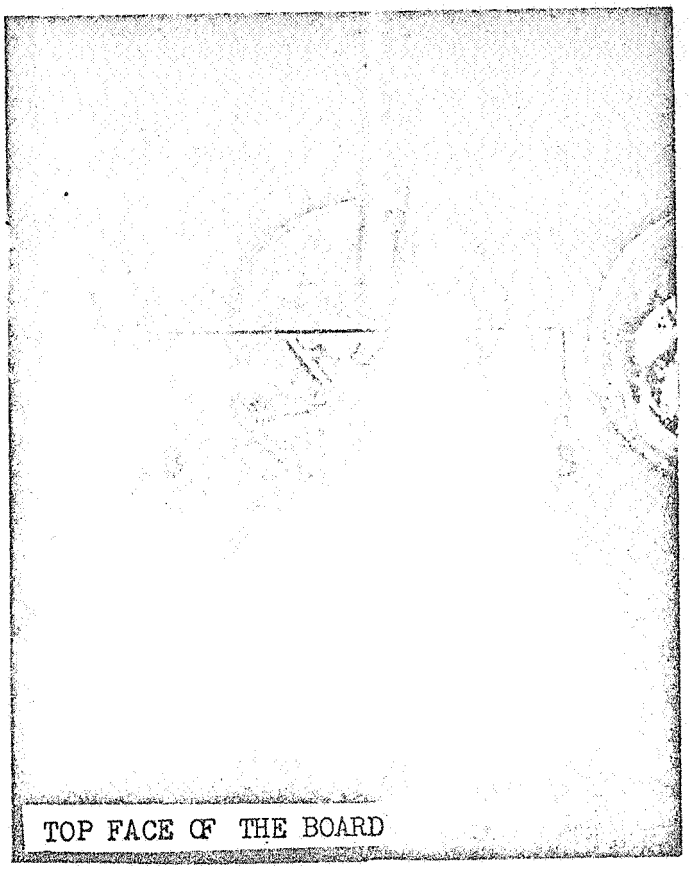
FIGURE 2



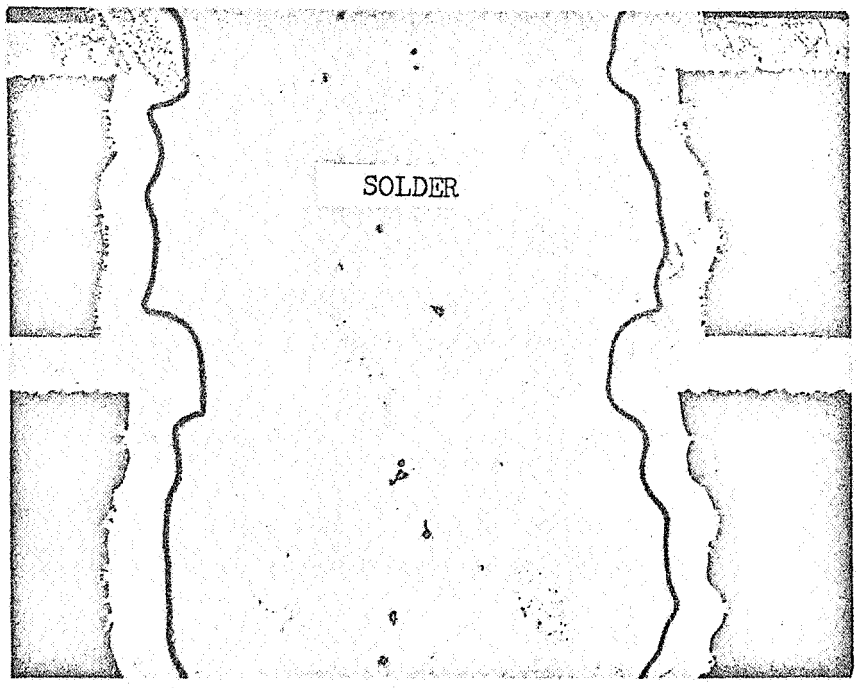
SECTION A-A

50X

CONNECTION B SHOW



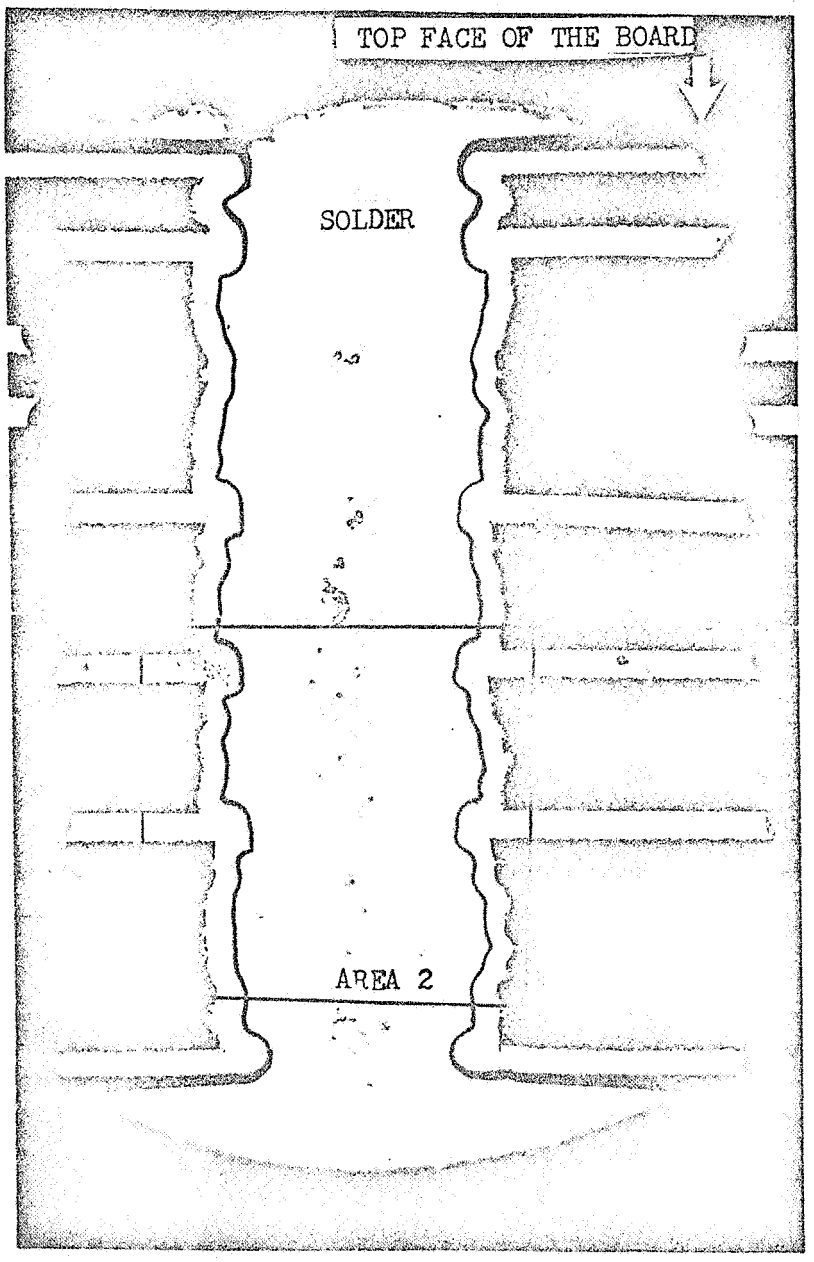
CONNECTION B 16X



AREA 2 (SECTION B-B) 100X

NG COMPLETE SOLDER FLOW

FIGURE 3



SECTION B–B 50X

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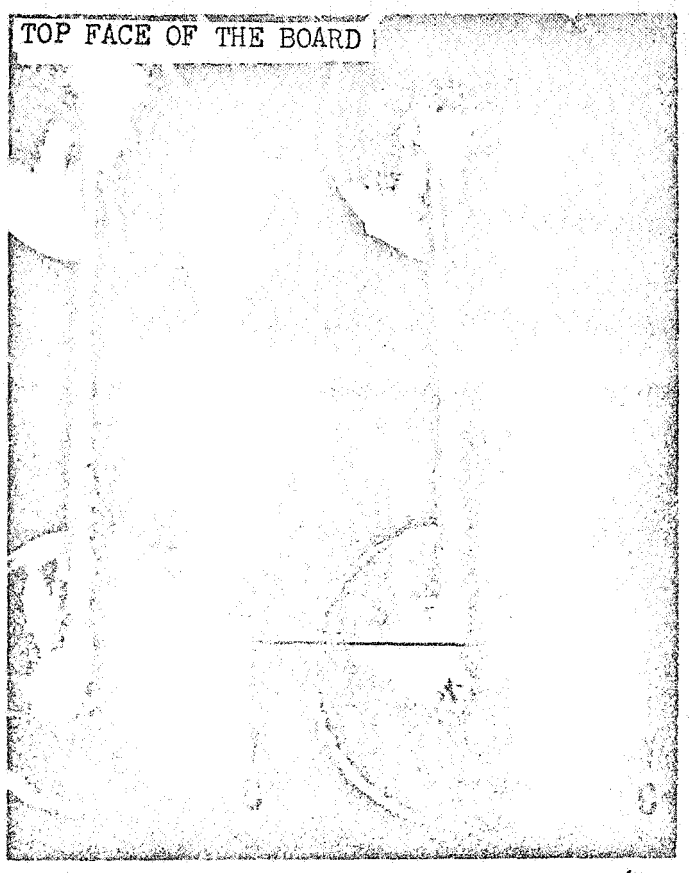
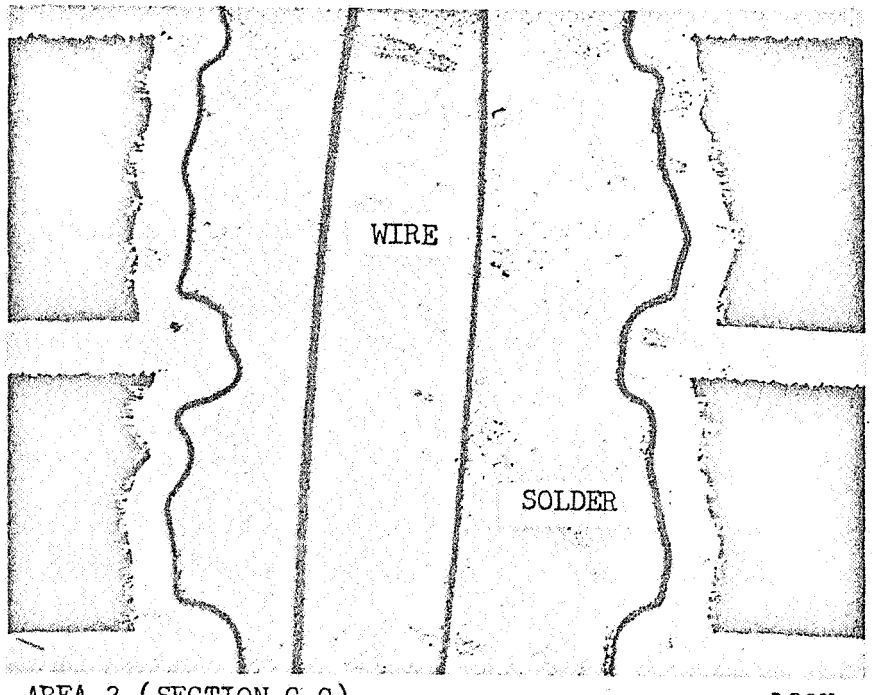
CONNECTION C SHOWI



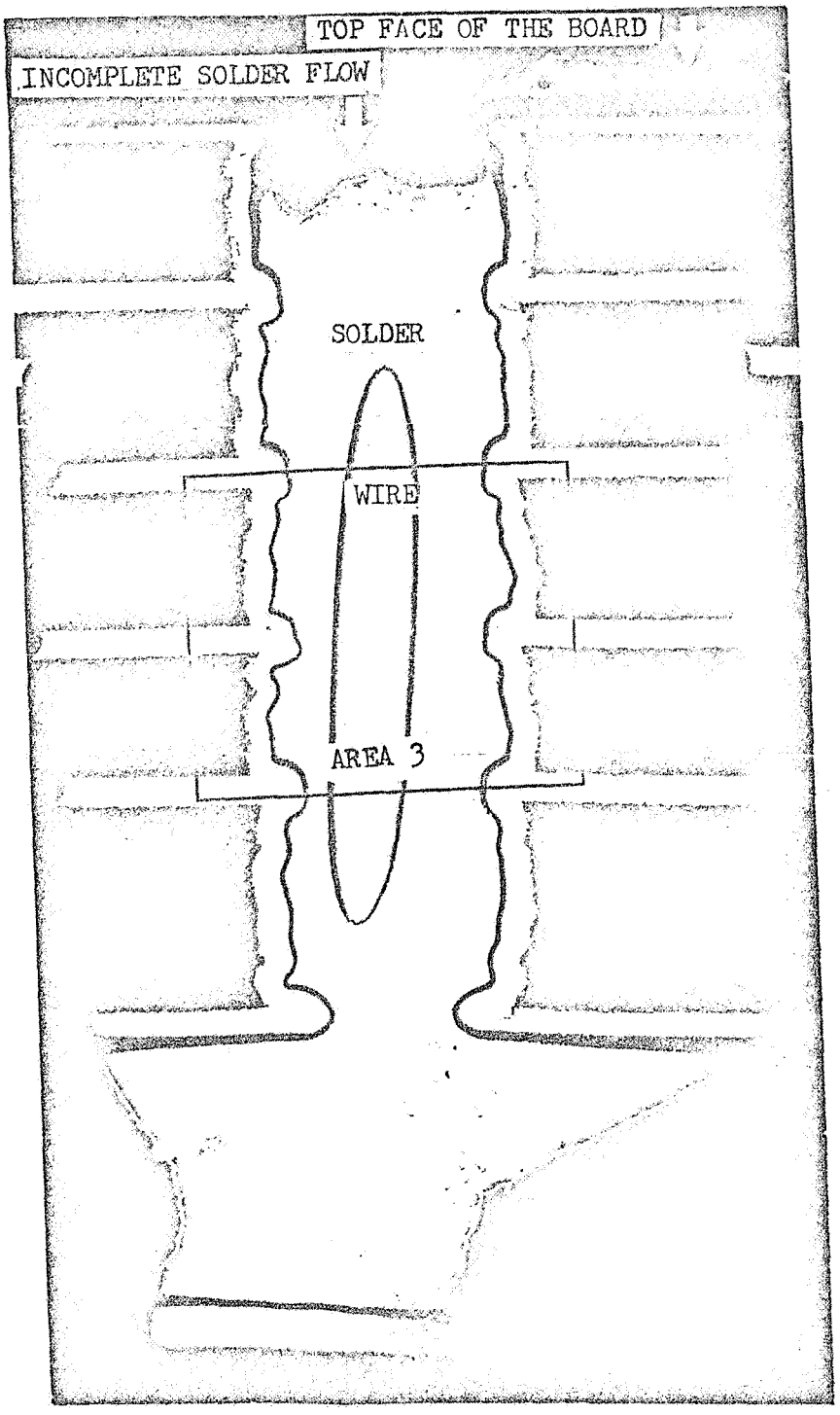
CONNECTION C 16X



AREA 3 (SECTION C-C) 100X

INCOMPLETE SOLDER FLOW

FIGURE 4



SECTION C-C

50X

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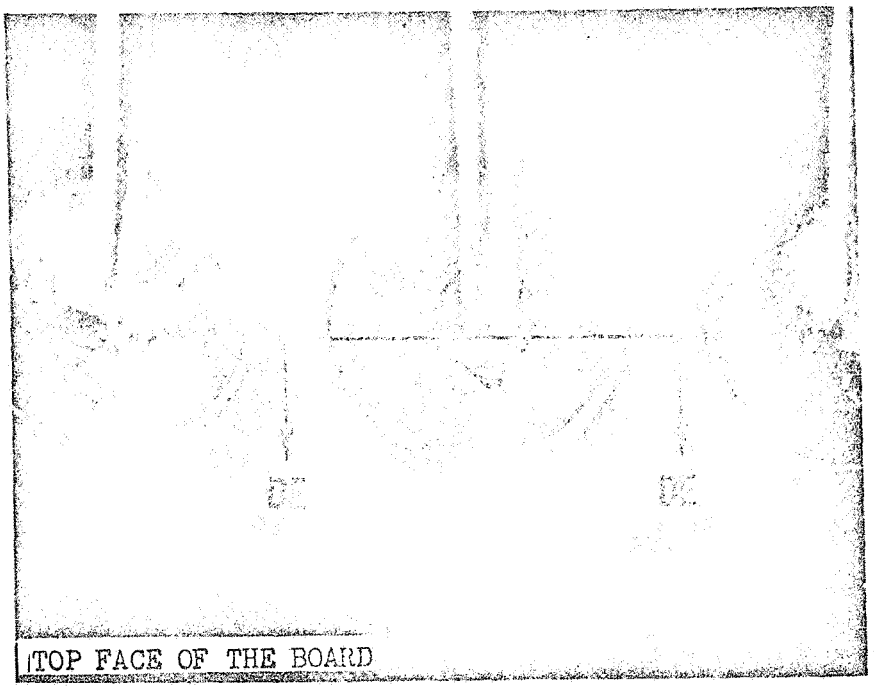
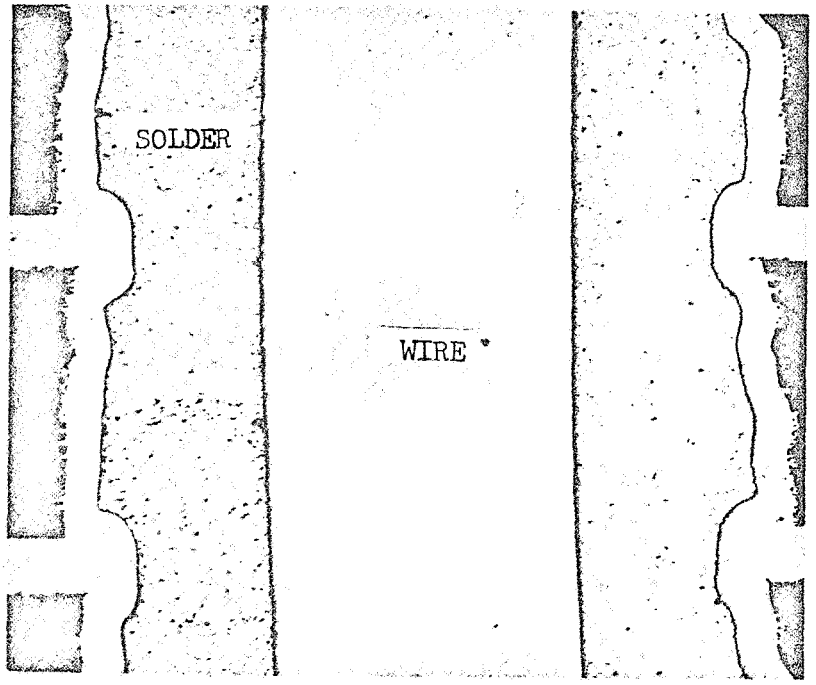
CONNECTION DE SHOWI



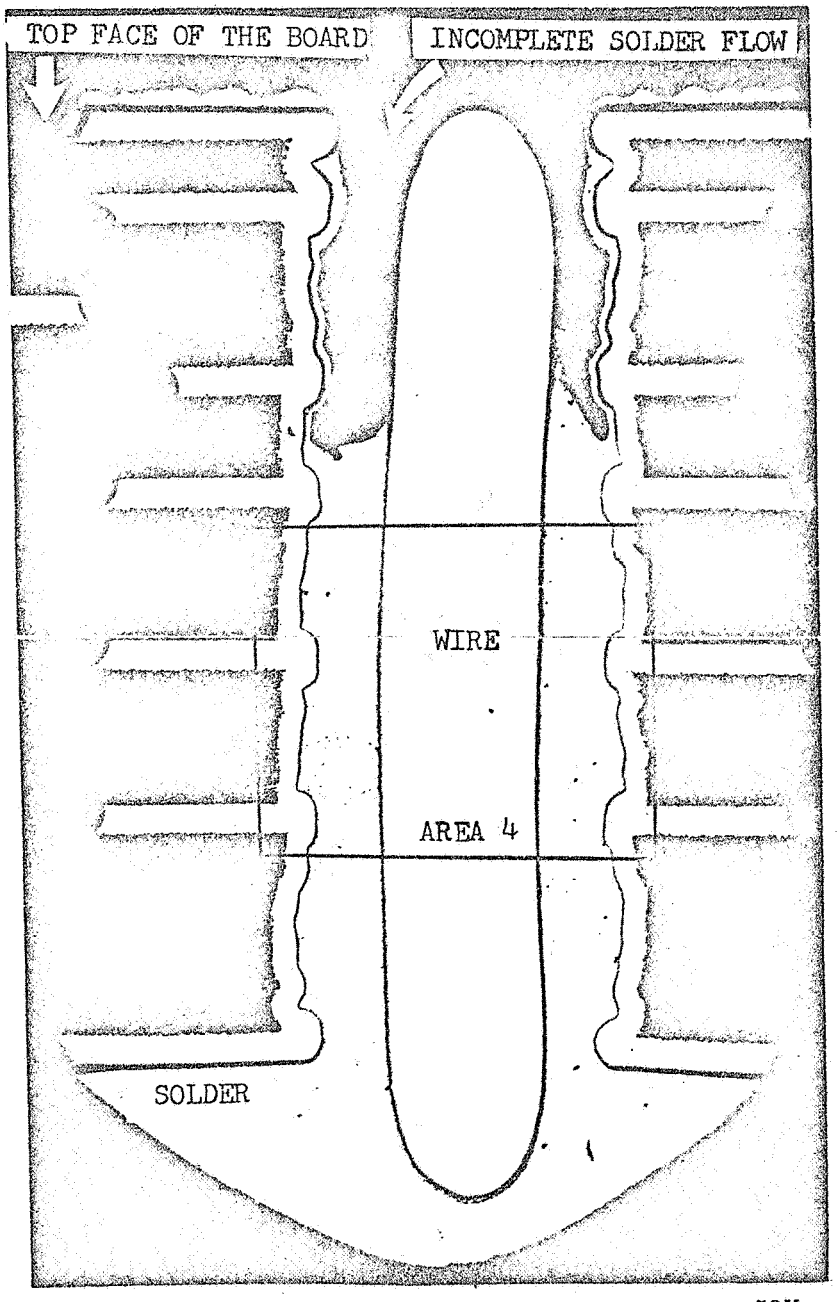
CONNECTION DE 16X



AREA 4 (SECTION DE-DE) 100X

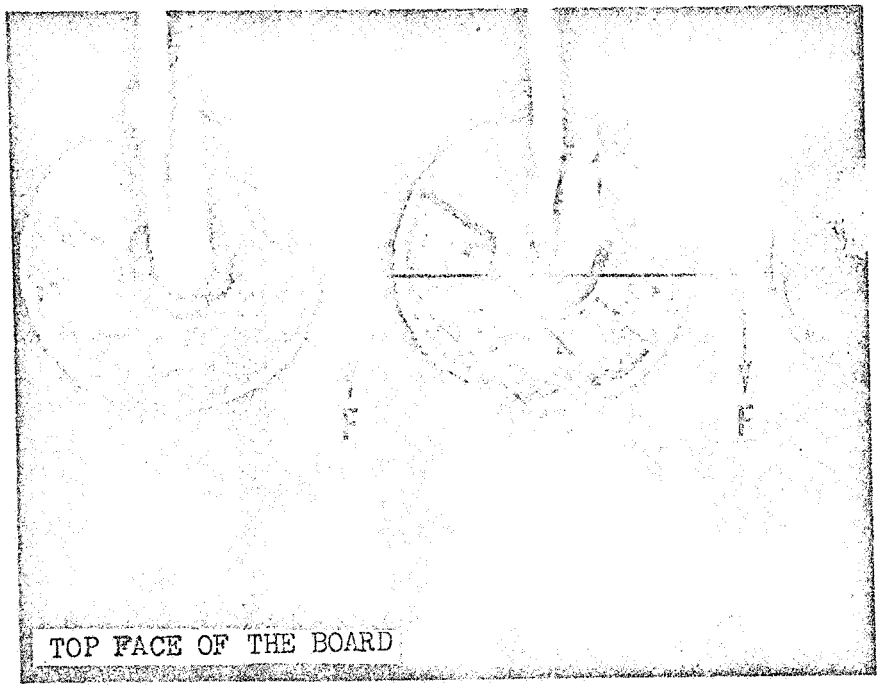
FIGURE 5

ICOMPLETE SOLDER FLOW

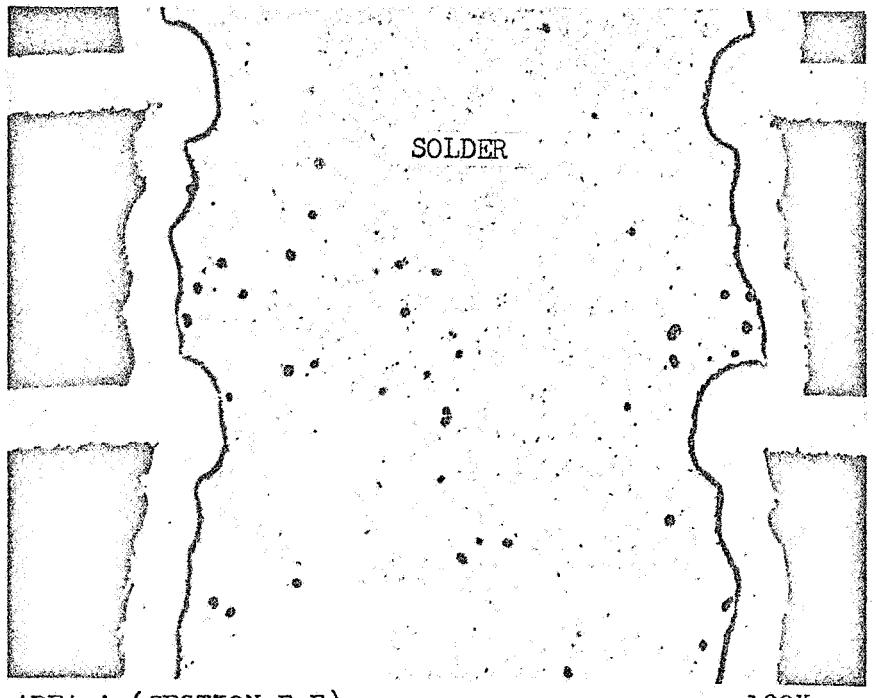


SECTION DE-DE 50X

CONNECTION F SHOWIN



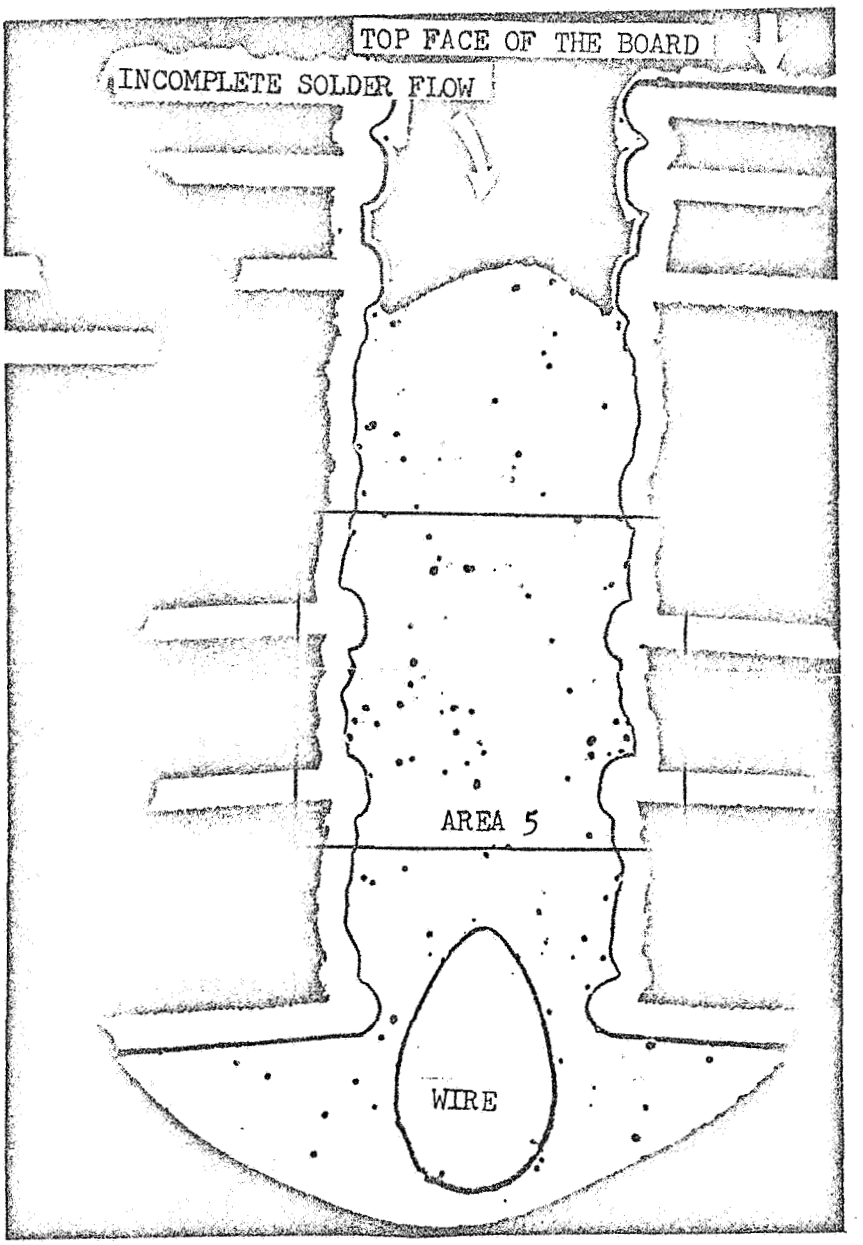
CONNECTION F 16X



AREA A (SECTION F-F) 100X

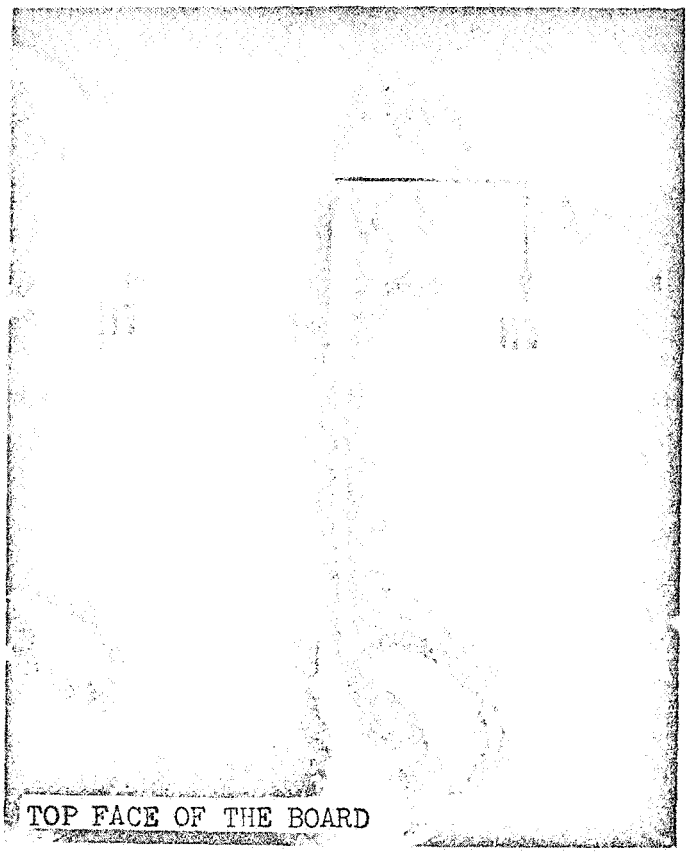
INCOMPLETE SOLDER FLOW

FIGURE 6

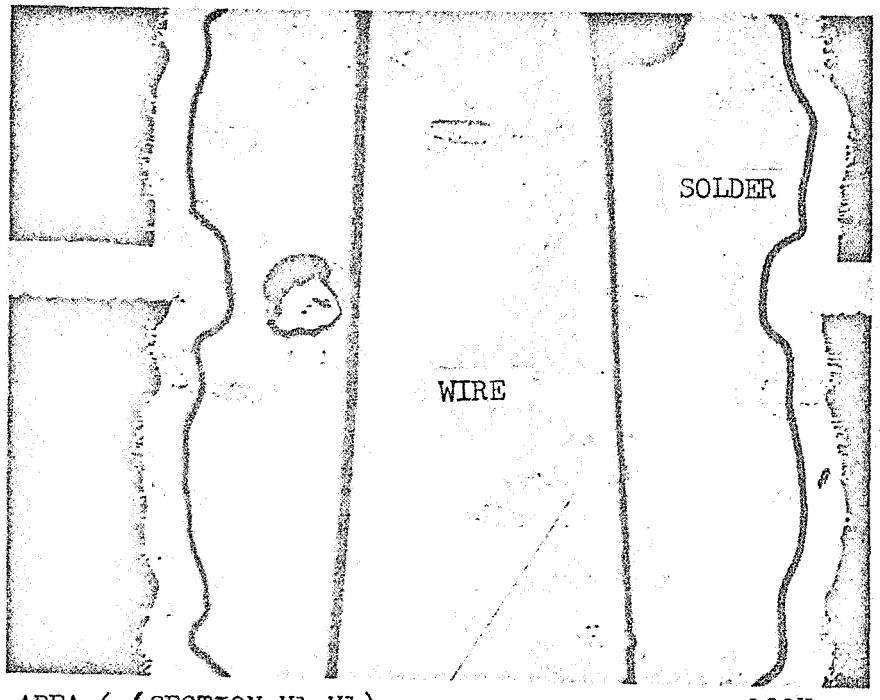


SECTION F-F 50X

CONNECTION H1 SHOWI
EXCEPT FOR



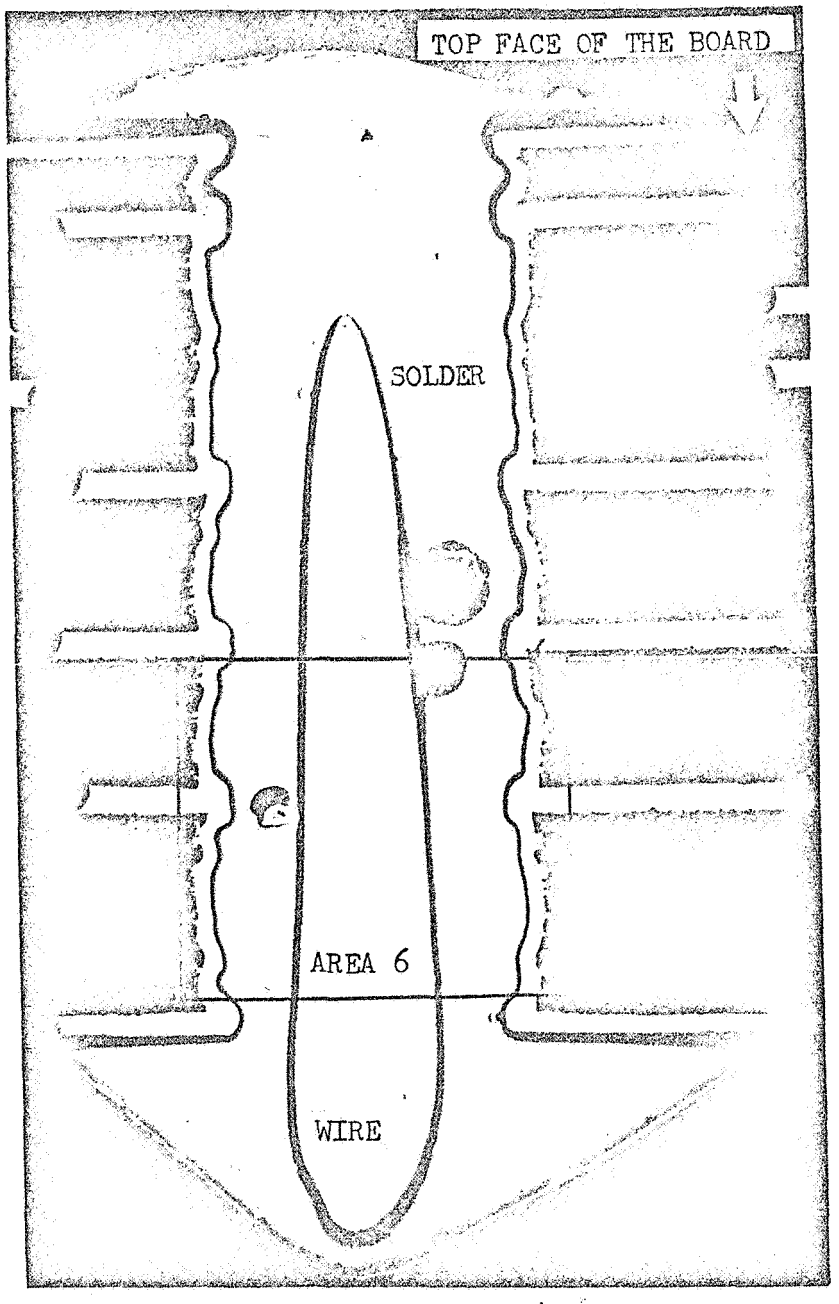
CONNECTION H1 16X



AREA 6 (SECTION H1-H1) 100X

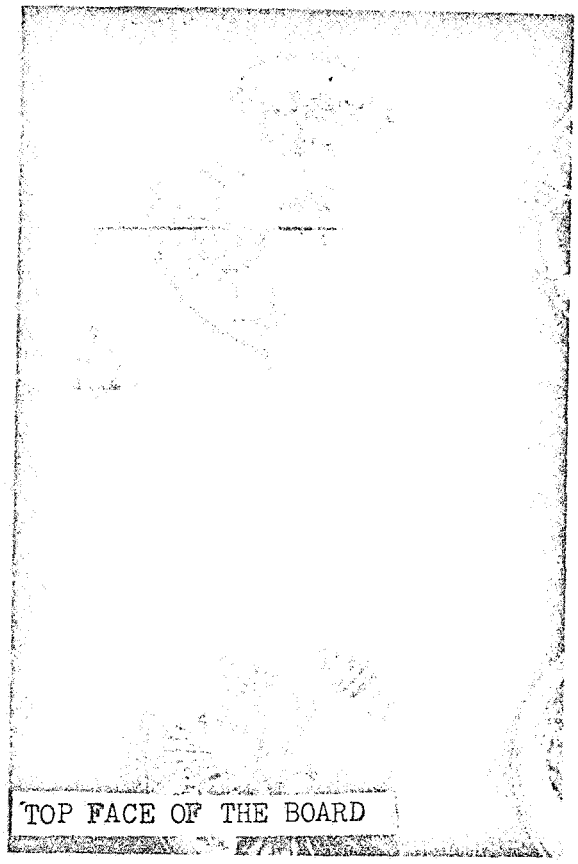
FIGURE 7

OMPLETE SOLDER FLOW
DS ALONG WIRE

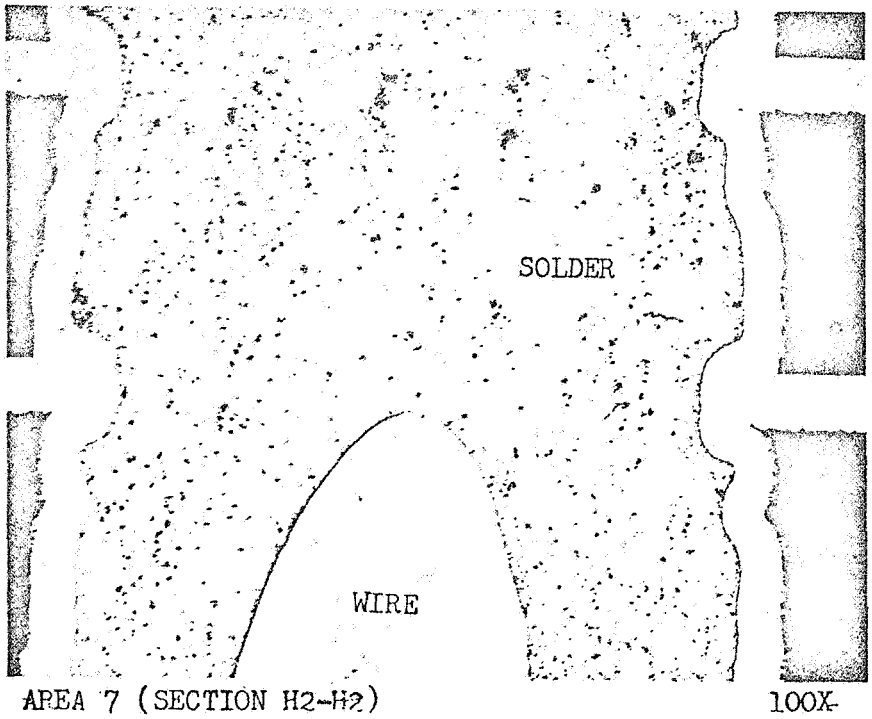


SECTION H1-H1 50X

CONNECTION H2 SH



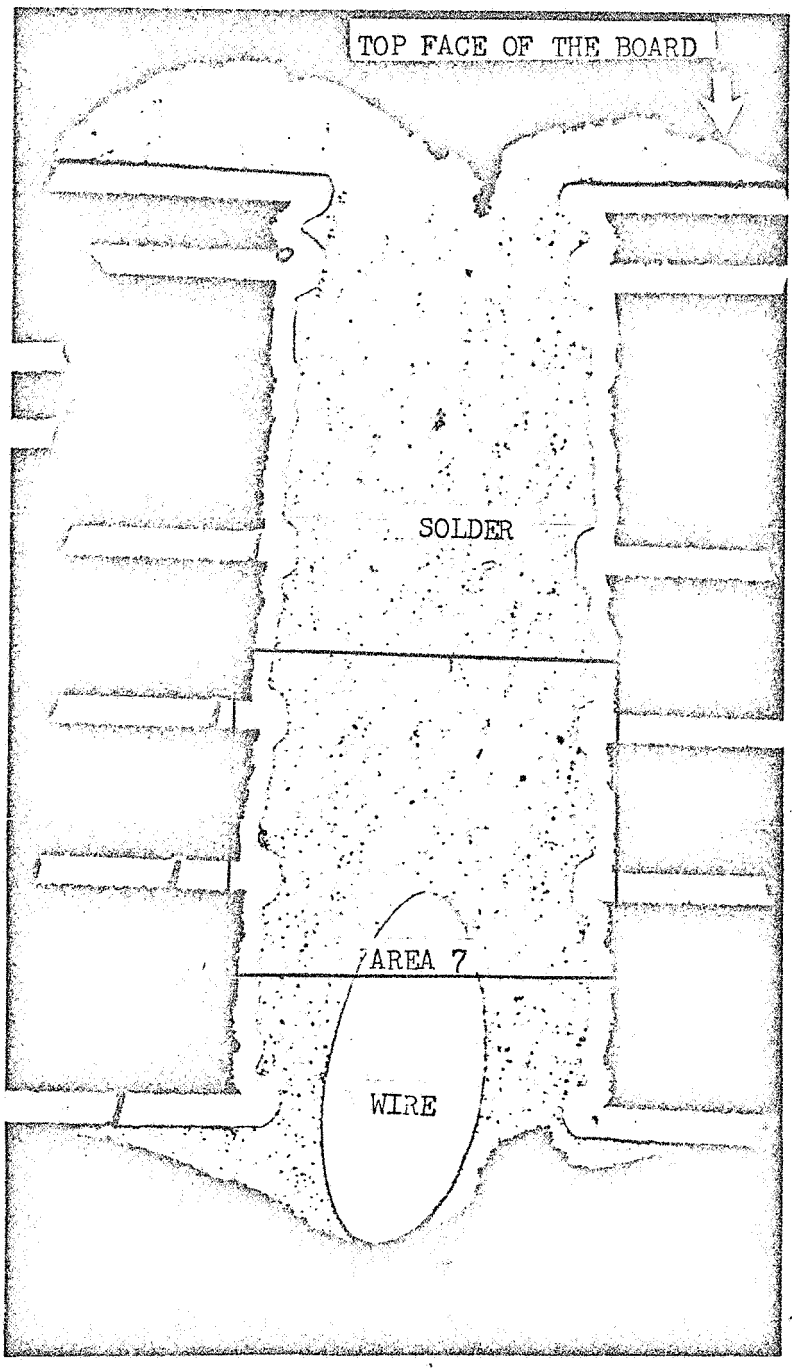
CONNECTION H2 16X



AREA 7 (SECTION H2-H2) 100X

FIGURE 8

G COMPLETE SOLDER FLOW



SECTION H2-H2 50X

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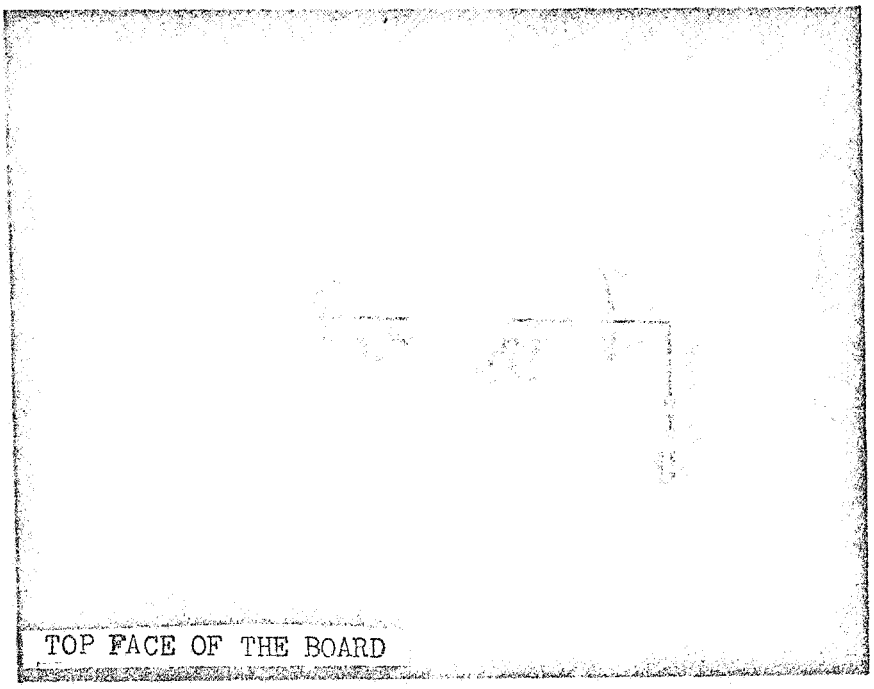
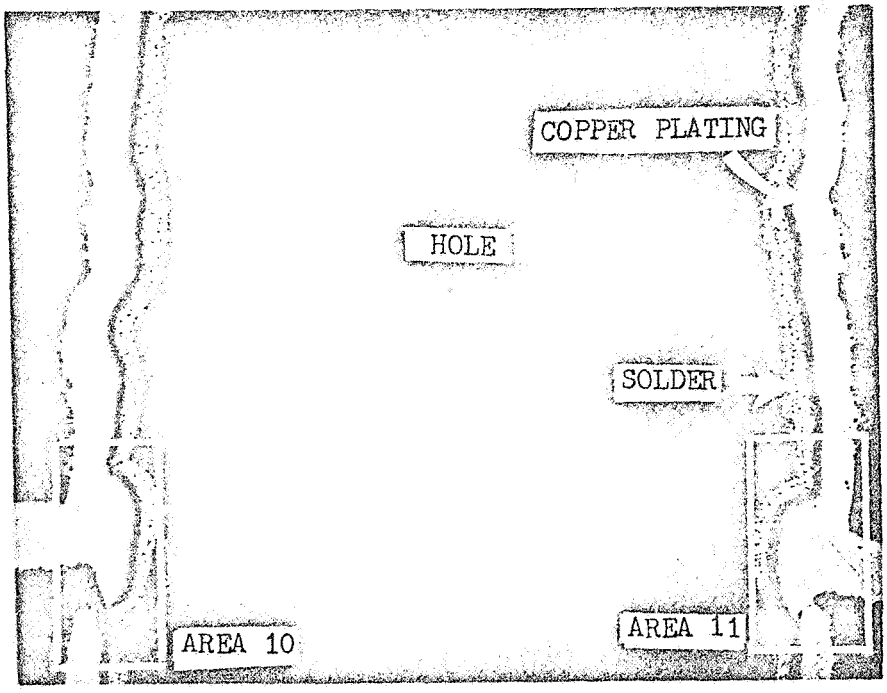


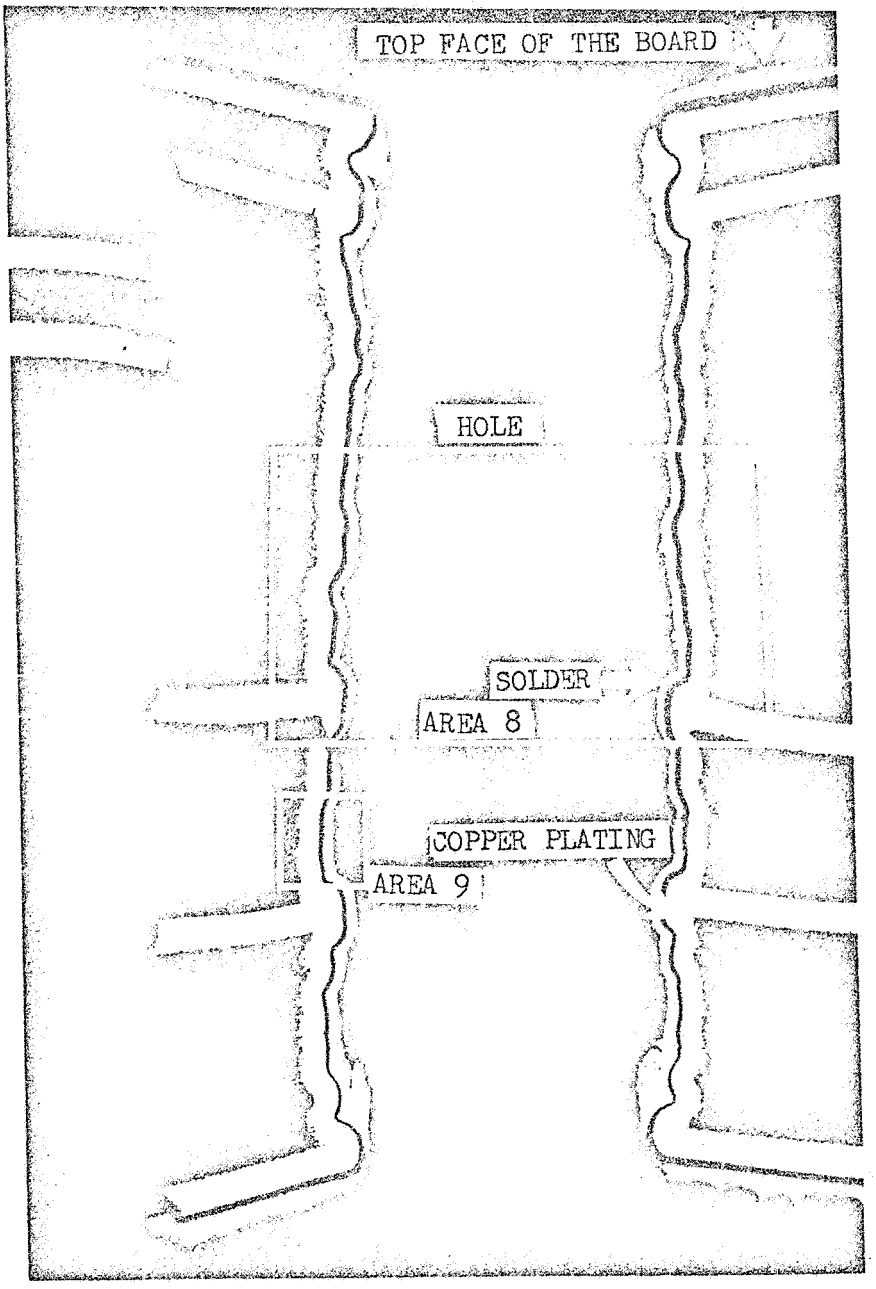
UNSOLDERED HOLE 16X



AREA 8 (SECTION U-U) 100X

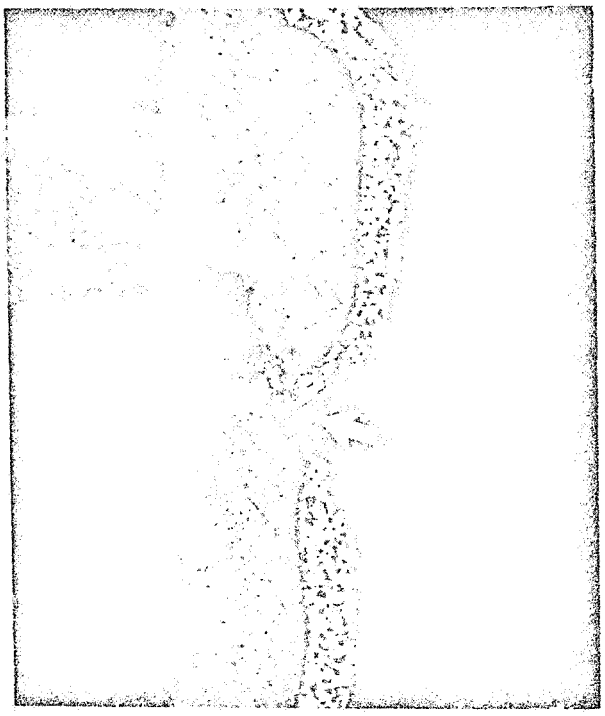
ED HOLE

FIGURE 9



SECTION U-U 50X

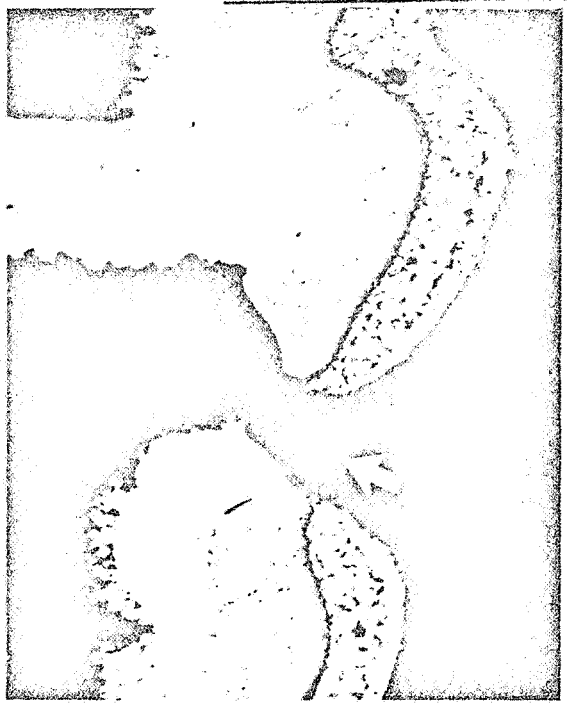
FIGURE 10 - AREAS 10 AND 11 OF SECTION U-U



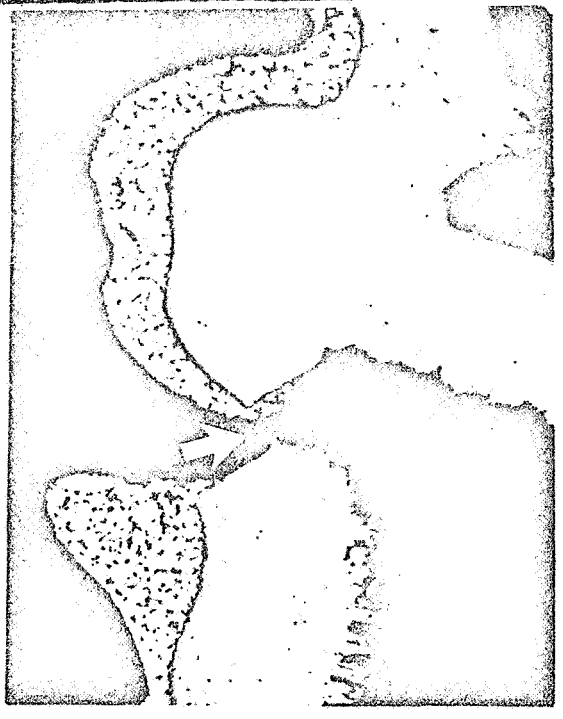
Area 10, Break in Copper Plate (arrow) 250X

Area 11, Crack in Copper Plate (arrow) 250X

FIGURE 11 SAME AREAS AS FIGURE 10 AFTER REPOLISHING



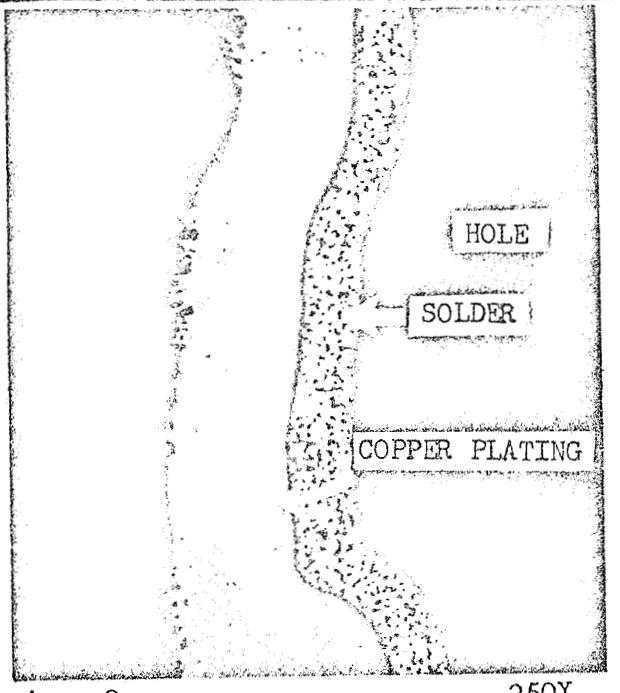
Area 10, Break in Copper Plate (arrow) 250X



Area 11, Break In Copper Plate (arrow) 250X

FIGURES 10, 11, 12

FIGURE 12-AREA OF SECTION U-U FROM WHICH THICKNESS MEASUREMENTS WERE TAKEN



Area 9 250X